A NORTHERN ADRIATIC POPULATION OF *THOROGOBIUS MACROLEPIS* (TELEOSTEI: GOBIIDAE)

by

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ABSTRACT. - A population of the large-scaled goby *Thorogobius macrolepis* (Kolombatovic, 1891) is described from the Bay of Rijeka, Croatia, north-eastern Adriatic Sea. Known to date only from three specimens, the discovery of the population of this small Gobiidae species permits the description of the variation of body proportions and of the head lateral-line system, the coloration in life, the sexual dimorphism, and also biological and ecological aspects. Data on the morphometrics, meristics and papillae counts are given. *T. macrolepis* is an epibenthic inshore species. It occurs on sandy substrate near crevices with vertical rock faces, from 6 to 42 m. Maximum SL is 52.6 mm in females, 54.8 mm in males. The urogenital papillae are of typical gobiid pattern and are developed in their characteristic shape for males and females at a size exceeding 28.5 mm SL.

RÉSUMÉ. - Sur une population de *Thorogobius macrolepis* (Teleostei: Gobiidae) en Mer Adriatique septentrionale.

Une population du gobie à grandes écailles, *Thorogobius macrolepis* (Kolombatovic, 1891), est décrite de la baie de Rijeka, Croatie, au nord-est de l'Adriatique. La découverte de cette population de petits gobies, connue jusqu'à présent par seulement trois spécimens, a permis de décrire la variation des proportions du corps et du système latéral de la tête, la coloration, le dimorphisme sexuel, et aussi des aspects de la biologie et de l'écologie de cette espèce. Des données morphométriques et méristiques ainsi que le nombre de papilles sont présentés. *T. macrolepis* est une espèce épibenthique côtière qui affectionne les fonds sableux situés entre -6 et -42 m de profondeur, à proximité de crevasses aux parois rocheuses verticales. La longueur standard maximale est de 52,6 mm pour les femelles et de 54,8 mm pour les mâles. Les papilles urogénitales sont typiquement celles d'un Gobiidae et leur forme, caractéristique des mâles ou des femelles, se développe à partir d'une taille de 28,5 mm SL.

Key-words. - Gobiidae, *Thorogobius macrolepis*, MED, North-Eastern Adriatic, Habitat, Biology.

More intensive collecting by conventional methods along with SCUBA techniques revealed that the infrequent capture of small fishes like gobies in the past is not always an indication of true numerical rarity in the ecosystem. On the contrary, the introduction of such techniques has recently repeatedly demonstrated the abundance and diversity of small gobiid fishes in the Mediterranean Sea (Ahnelt *et al.*, 1994; Kovacic, 1994; Ahnelt and Patzner, 1995, 1996). Nevertheless the abundance, the biology and even the habitat of several gobiid species still remain largely completely unknown, as e.g. for *Corcyrogobius liechtensteini* (Kolombatovic, 1891) and *Gammogobius steinitzi* Bath, 1971 (Ahnelt and Patzner, 1996). Another example of a poorly known Mediterranean gobiid fish is the large-scaled goby, *Thorogobius macrolepis* (Kolombatovic, 1891).

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This goby, which until recently has been reported from two Mediterranean localities only, was regarded as a junior synonym of *Lesueurigobius friesii* (Malm, 1874) by Sanzo (1911), De Buen (1923), Ninni (1938), Soljan (1975) and Abel (1983). Miller (1969) redescribed this species and assigned it to the genus *Thorogobius*, based on the two syntypes preserved in the Naturhistorisches Museum Wien. All informations concerning this rarely found species is based on three males only, two of them the syntypes of Kolombatovic's original description (Miller, 1986; Miller *et al.*, 1973). The discovery of populations of *T. macrolepis* in the northern Adriatic Sea by one of us (M.K.) is therefore important not only for the knowledge of the biology of this species, but also for the coloration, the sexual dimorphism and, with some restrictions, the variability of this gobiid species. The new records from the Adriatic Sea and from the Western Mediterranean basin (Ahnelt and Patzner, 1996) make it likely that the large-scaled goby occurs in the entire Mediterranean.

Nevertheless, the distribution area of *T. macrolepis* seems to be more restricted than that of the closely related *T. ephippiatus* (Lowe, 1839). While *T. macrolepis* is possibly confined to the Mediterranean Sea, the latter species ranges from the Mediterranean, northwards as far as Sweden (Miller, 1986), westwards as far as the Azores (Azevedo *et al.*, 1990) and southwards as far as the Salvage Islands, immediately north of the Canaries (Miller, 1969).

The habitat of both species is typically sublittoral (Miller, 1969; Miller *et al.*, 1973; Wilkens and Myers, 1993). Both are wary and disappear into rock crevices or small holes unter stones when approached. *T. macrolepis* does not show more distinct cryptic behaviour then *T. ephippiatus*: one cannot conclude that the large-scaled goby has been overlooked in areas outside of the Mediterranean in which *T. ephippiatus*, also an extremely wary species (Miller, 1969), had been found repeatedly.

METHODS AND ABBREVIATIONS

Meristics

A, anal fin; C, caudal fin; D1, D2, first and second dorsal fins; LL, scales in lateral series; P, pectoral fin; V, Pelvic disc.

Morphometrics (see Table I)

Ab, anal fin base; Ad and Aw, body depth and width at anal fin origin; Cl, caudal fin length; Chd, cheek depth; CP and CPd, caudal peduncle length and depth; d, damaged C; D1b and D2b, first and second dorsal fin bases; E, eye diameter; H and Hw, head length and width; I, interorbital width; Pl, pectoral fin length; PO, postorbital length; SL, standard length; SN, snout length; SN/A and SN/AN, distance from snout to vertical of anal fin origin and anus; SN/D1 and SN/D2, distance from snout to origin of first and second dorsal fins; SN/V, distance from snout to vertical of pelvic spinous ray origin; TL, total length; V/AN, distance from origin of pelvic spinous ray to anus; Vd, body depth at origin of VI; VI, distance from VI origin to tip of longest pelvic ray.

Lateral-line system (see Table II)

Terminology follows Sanzo (1911) and Miller (1986).

Head canals. Pores are marked with Greek lettering.

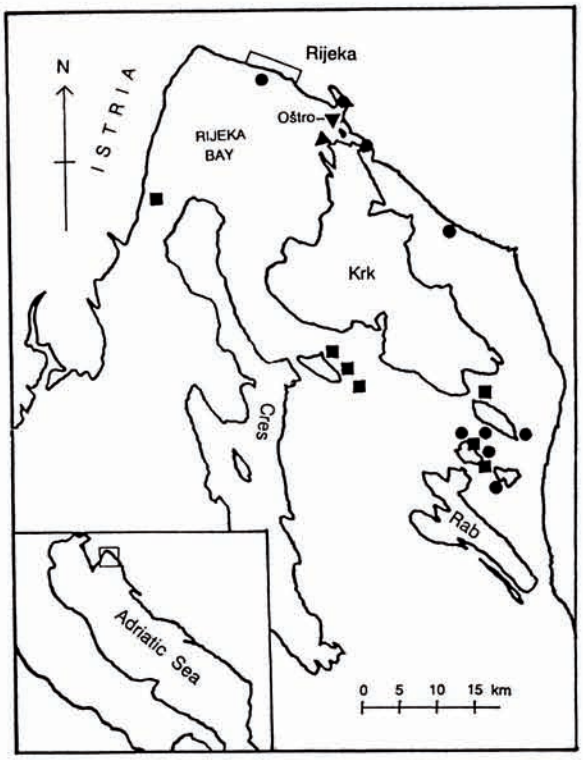

Fig. 1. - Collecting sites (triangles) and records (full circles) of *Thorogobius macrolepis* and (squares) *Thorogobius ephippiatus* in the Gulf of Kvarner, Croatia.

Series of sensory papillae. AD, anterior dorsal; OP, opercular; OS, oculoscapular; PM, preopercular-mandibular; PO, preorbital; SO, suborbital.

Institutions

NMW, Naturhistorisches Museum Wien.

Profile and abundance

To provide a profile of the depths at which *T. macrolepis* occurs, a series of line transects were laid perpendicular to the shoreline. The lines were marked at 1 m intervals, and data on depth and substratum type were taken at each of these marks (Costello *et al.*, 1990). The abundance of *T. macrolepis* was determined using a modified method of Costello *et al.* (1990). In addition, transect lines which follow the isobaths were laid parallel to the shoreline. A 10 m stretch of each such transect was marked every 1 m. Individuals were counted every meter and 1 m each side. Each observation thus covered 2 m^2, a complete transect 20 m^2. Twelve parallel transects were positioned within a depth range of *T. macrolepis* at Ostro (Fig. 1). Each transect was counted three times. The classification of the benthic biocoenosis and algal cover follows Peres and Gamulin-Brida (1973).

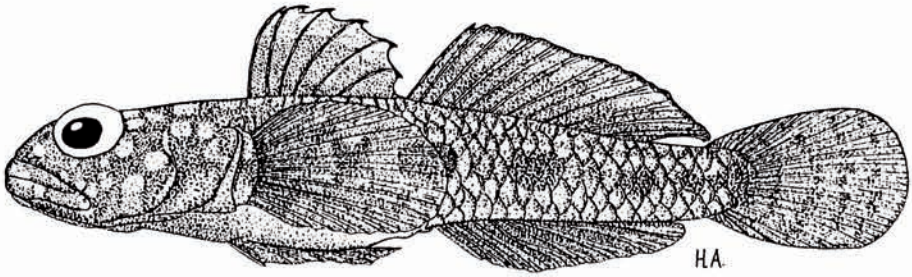

Fig. 2. - *Thorogobius macrolepis*. Male, 51.8 + 11.8 mm. Gulf of Kvarner, Ostro; Aug. 25, 1995. Scale bar = 10 mm.

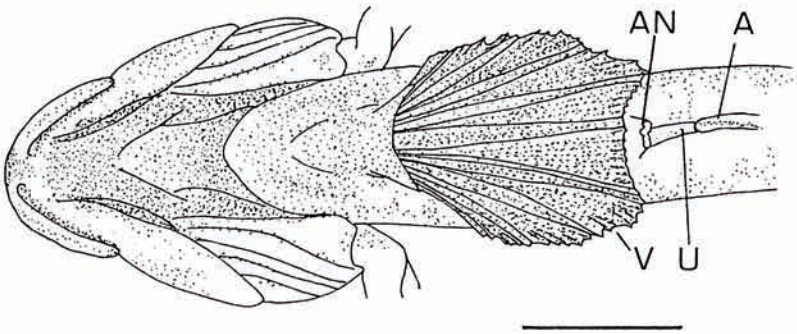

Fig. 3. - *Thorogobius macrolepis*. Male, 49.8 + 11.7 mm. Ventral view of head and abdomen; A - origin of anal fin, AN - anus, U - urogenital papilla, V - ventral disc. Gulf of Kvarner, Ostro; June 15, 1995. Scale bar = 7 mm.

Study area

Thirty-two localities in the Gulf of Kvarner, Adriatic Sea, were investigated by SCUBA techniques during the years 1994 and 1995. At 11 sites the large-scaled goby was present in varying abundance. This gulf is relatively shallow, with a maximum depth range of 50-60 m in its western part and 60-80 m in its eastern part. Specimens were collected at two sites in the northern part of the Gulf of Kvarner, in the Bay of Rijeka at Ostro. Data and material were collected from June 1 to August 25, 1995.

THOROGOBIUS MACROLEPIS (KOLOMBATOVIC, 1891)

(Figs 2,3)

Material

Croatia, Split; 2 males, 47 + d mm; NMW 37421-422; syntypes; leg. G. Kolombatovic.

Croatia, Bay of Kvarner, Ostro; 10 males, 28.8 + 7.2 - 54.8 + 13.7 mm; 9 females, 28.7 + 7.1 - 52.6 + 12.7 mm; 2 specimens, sex?, 24.3 + 6.5 - 26.9 + 7.1 mm; July and Aug. 1995; Bay of Kvarner, Selehovica; 1 male, 53.4 + 14.4 mm; 11. Aug. 1995; leg. M. Kovacic.

Spain, Ibiza; 1 female, 42.1 + 9.9 mm; Sep. 1994; leg. R.A. Patzner.

Nomenclature

Kolombatovic (1891) described *T. macrolepis* (as *Gobius macrolepis)* from Dalmatia near Split, Croatia. This small gobiid species was regarded as a Mediterranean subspecies of *Gobius friesii*, now placed in *Lesueurigobius*, by De Buen (1923) and subsequent authors (discussed by Miller, 1969). In literature dealing especially with the Adriatic fish fauna, both species are still confused with each other (Soljan, 1975), or *L. friesii* is misidentified as *T. macrolepis* (Abel, 1983). Because this literature is frequently used at universities and during marine biological courses we summarize easily recognizable differences between *T. macrolepis* and the genus *Lesueurigobius* (characteristics of the latter in parentheses). Among others, the large-scaled goby differs from the latter genus in: (i) body cylindrical (body compressed); (ii) D1 lacking elongate rays (D1 with elongate rays); (iii) head profile less convex (head profile distinctly convex); and (iv) transversal SO series of the head lateral-line system present (only horizontal SO series developed).

Description

Body proportions are given in table I.

Fins

D1 VI-VII (VI:21, VII:1); D2I/10-11 (10:6, 11:16); AI/9-11 (9:5, 10:16, 11:1); P 17-18 (17:7, 18:15); C 13-16 (13:3, 14:12, 15:3, 16:4).

Scales

Head, nape and predorsal area naked to third to fifth ray of D1. Scales ctenoid, LL 29-31 (29:4, 30:11, 31:6, abraded:1).

Size

The largest female in our samples reached a TL of 65.3 mm, the largest male a TL of 68.5 mm. This is larger for both sexes than the estimated size range for the two syntypes (Miller, 1969). We assume that the large-scaled goby does not reach a size more then 70 mm. Even at 70 mm, *T. macrolepis* belongs to the small gobiid species, i.e. those not exceeding a TL of 100 mm.

Lateral-line system

As in figure 4 and table II.

Coloration

Preserved males. - Body grayish fawn, ventral side paler, with a reticulate pattern along scale edges. Five, rarely six dark blotches along lateral midline, longer than deep. First blotch below middle of D1, second below origin of D2, third below posterior third of D2, fourth and fifth at the origin and at the end of CP respectively; a sixth blotch may be present between 4 and 5. Four indistinct bands along the body sides; one dark band along lateral midline, of the same height as the dark blotches; two narrow bands dorsal, one narrow band ventral to midline. Head, nape and predorsal area similar as body but covered with numerous pale spots. Ventral side of head and branchiostegal membrane dark. The pale spots are distinct on the dorsal and lateral sides of the head, including opercle and cheeks, and on the predorsal area, including the scaleless angles on both sides of the anterior half of D1. Spots are less distinct on snout and on upper lip. Unpaired fins dusky to dark. D1 dusky, finrays with distinct black tips; D1I and D1II with three dark markings,

less distinct on the other rays, indicating the origin of three horizontal bands, barely visible in the dusky fin of males during the spawning season; margin of D1 transparent immediately below the black tips. D2 dusky, first ray with three dark markings, indicating the origin of three horizontal bands; edge of D2 dark, transparent below. C dusky, with four to five vertical series of dark spots which form indistinct rows, barely visible in the ventral third of the fin; edge of C somewhat darker than rest of fin. V and A uniformly dark, darker than the dorsal fins, tips of finrays transparent. P transparent, somewhat dusky in reproducing males. Base of P dark with a light blotch in its dorsal quarter. Urogenital papilla and circum-anal area whitish, in distinct contrast with dark A and V.

Table I. - Body proportions of *Thorogobius macrolepis*. Values are range, and, in parentheses, mean and standard deviation. See text for abbreviations.

	Sex	Males	Females
	n	6	6
	SL (mm)	42.7 - 54.8	47.6 - 52.6
%SL,	H	30.0-31.8 (30.9, 0.57)	30.7-31.3 (31.0, 0.23)
	Hw	12.8-13.4 (13.2, 0.25)	12.7-13.5 (13.1, 0.26)
	SN/D1	34.8-37.0 (35.5, 0.81)	37.4-35.9 (36.6, 0.61)
	SN/D2	53.3-55.7 (54.6, 0.78)	55.0-56.9 (56.0, 0.76)
	SN/AN	54.1-56.2 (55.2, 0.68)	55.0-58.1 (56.5, 1.01)
	SN/A	57.2-58.2 (57.7, 0.35)	59.3-62.2 (60.8, 1.07)
	SN/V	29.7-32.2 (30.7, 1.18)	30.6-32.3 (31.8, 0.71)
	CP	24.2-26.1 (25.2, 0.70)	22.9-25.5 (23.9, 0.89)
	D1b	11.8-13.5 (12.7, 0.70)	11.8-13.5 (12.3, 0.60)
	D2b	25.0-26.6 (25.8, 0.61)	23.9-25.9 (24.7, 0.73)
	Ab	17.5-19.8 (18.8, 0.85)	17.6-19.3 (18.4, 0.56)
	C1	22.5-25.4 (24.1, 1.08)	20.4-24.3 (23.0, 1.41)
	P1	26.1-30.7 (28.1, 1.93)	26.6-29.5 (27.6. 1.21)
	V1	23.6-26.7 (25.4, 1.00)	22.5-26.1 (24.9, 1.38)
	Vd	17.8-20.1 (19.1, 0.91)	17.0-18.8 (18.2, 0.66)
	Ad	14.8-17.5 (16.1, 0.91)	14.2-16.0 (14.9, 0.61)
	Aw	10.8-13.1 (11.9, 0.74)	8.7-10.3 (10.2, 1.06)
	CPd	8.8-10.4 (9.9, 0.60)	8.3-10.1 (8.9, 0.63)
	V/AN	23.7-26.4 (25.7, 1.20)	23.5-26.8 (25.9, 1.36)
%CP,	CPd	34.3-41.9 (39.4, 2.81)	34.5-38.7 (37.1, 1.55)
%H,	SN	29.9-33.8 (32.4, 1.62)	28.6-35.8 (30.7, 2.68)
	E	26.1-30.9 (29.1, 1.85)	28.5-35.8 (30.5, 2.71)
	PO	43.0-47.8 (45.5, 1.89)	44.8-46.3 (45.6, 0.56)
	CHd	23.1-25.8 (24.7, 1.00)	20.9-24.3 (22.7, 1.34)
	Hw	41.1-44.5 (42.6, 1.35)	41.1-43.4 (42.3, 0.81)
%E	I	10.9-17.1 (15.2, 2.35)	10.9-13.7 (12.0, 1.23)
%V/AN	V1	98.6-107.9 (99.3, 7.26)	93.0-99.2 (95.9, 2.05)

Preserved females. - Similar to preserved males, but generally lighter. Ventral side of head from pale to dusky; no mental spot; branchiostegal membrane transparent. Unpaired fins transparent. Finrays of D1 with black tips, less distinct than the males. Three irregular horizontal bands, the first at the finbase, sometimes short and then ending at the base of the fifth ray, the two distal bands extending over the entire D1; bands originate as distinct dark spots on the first ray. D2 with four irregular horizontal bands. Edge of transparent A dusky. V and P transparent.

Living males (from a colour-slide). - As preserved, less grayish. Blotches along lateral midline brown-orange. Irregular spots on head, nape and predorsal area (naked) orange to yellow; dorsal, scaled part of the body with irregular orange spots; bright light orange to yellow spots on the snout, the upper lip and a few on the lower lip over the symphysis; small yellow spots on the dark pigmented dorsal part of the eyes (either

Thorogobius macrolepis **SL 42.7 - 54.8 mm** **n = 14**			
PO		**OS**	
r1	3-8 (5-8)	x1	11-18 (11-16)
r2	3-7 (3-7)	x2	4-7 (3-6)
s1	3-6 (3-6)	y	1-2 (1)
s2	4-7 (4-7)	z	6-12 (4-10)
s3	3-5 (2-4)	q	3-6 (3-6)
c2	5-8 (5-7)	as1	7-12 (7-9)
c1	3-6 (4-6)	as2	5-10 (6-10)
c2	5-8 (4-8)	as3	7-14 (8-13)
c1	2-4 (2-5)	la1	3-7 (4-6)
SO		la2	4-7 (3-6)
1	11-15 (10-15)	**OP**	
2	8-12 (9-11)	ot	23-32 (25-34)
3	9-12 (8-11)	os	9-15 (10-15)
4	9-13 (10-13)	oi	6-9 (5-9)
5s	0-6 (0-6)	**AD**	
5i	7-10 (6-11)	n	0-9 (6-10)
6s	5-10 (4-10)	g	10-15 (10-15)
6i	13-22 (14-22)	o	0-7 (4-7)
7	1-3 (1-3)	m	4-7 (4-8)
b	11-18 (13-17)	h	13-23 (15-21)
d	21-29 (21-29)		
PM			
e	45-57 (45-65)		
i	16-21 (17-21)		
f	11-16 (11-15)		

Table II. - Numbers of sensory papillae of the left side (right side in parentheses) in the head lateral-line system of *Thorogobius macrolepis*.

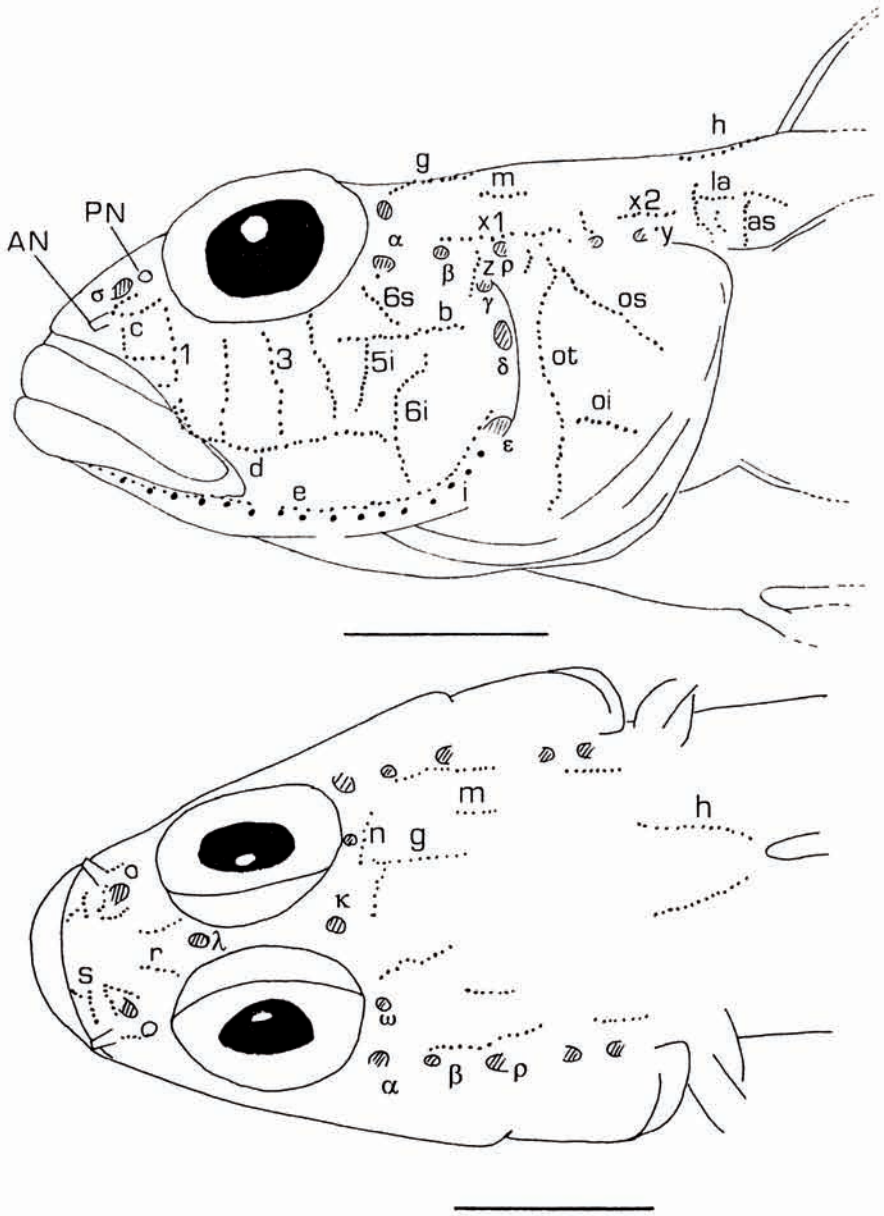

Fig. 4. - *Thorogobius macrolepis*. Lateral-line system of the head with pores of the head-canal system (Greek lettering) and sensory papillae in A: lateral and B: dorsal view. Anterior-dorsal and suborbital sensory papillae series atypically developed (explanation in text). Female, 49.5 + 10.1 mm. Gulf of Kvarner, Ostro; June 15, 1995. Scale bar = 5 mm.

single and larger, or in pairs and smaller) and forming a row of 4-7 small spots along the posterior and ventral margin of the eyes. Bands of D1 and D2 formed by orange spots;

origin of bands as three small dark brown blotches on the first finray. Brown spots, visible also in preserved specimens, form together with orange to yellow spots the bands of C. Edge of D1 yellow, tips of rays black. Three yellow bands in D1 and D2, lower most at the fin bases. P base with one to two orange spots. Orange and yellow spots occur mostly dorsal of lateral midline. During the reproductive period most of the body is dominated by dark to dusky coloration.

Living females (from a colour-slide). - In general similar to males but lighter. Ventral side of head and abdomen whitish. Orange and yellow spots on head and body as in males. Unpaired fins transparent to somewhat dusky with three yellow-orange bands. V and P uniformly transparent, somewhat dusky near bases.

Sexual dimorphism. - Is evident in both sexes for spawning specimens in life and in preserved state. During the reproductive period males are dark, females distinctly lighter. The light coloration of the latter corresponds well with the color of the sand, which dominates the preferred habitat of this species, while the dark coloration of males contrasts with it.

Biology

Abundance

T. macrolepis is a benthic species living on soft sediment, but always near rocky shelters. When approached the fishes withdrew into the crevices, holes and small caves typical for their habitat. Several holes and crevices were always connected with one other, thus forming more or less extensive crevice-systems with several entrances. This was tested with liquid dye. It was impossible to estimate the extent of such systems of holes and small caves. This type of habitat and the cryptobenthic behavior of the goby make it difficult to determine the population density of *T. macrolepis*. The specimens were mostly seen single, only rarely were two specimens close together. The numbers here must therefore be interpreted more as minimum estimates of the population density than as averages. The average density of this goby over all twelve transects at Ostro was 0.20 ind./m^2. The density per m^2 over the bedrock, where seven transects were positioned, was 0.15, while at the transition from the rocky slope to the soft sediment of the sea-bottom, where five transects were laid, this value was 0.29.

Depth distribution (Fig. 5)

T. macrolepis was not recorded in < 6 m depth. Specimens were observed at depths between 6 m and 40 m, but occurred most frequently from 11 m to 25 m. No different depths or habitat preference were observed between adult males and females as well as subadult individuals. These three members of the population were also always found in a similar abundance. In the Balearic Islands this species is also known to occur in a depth of about 40 m (Ahnelt and Patzner, 1996). In the study area at Ostro, Bay of Rijeka, the depth range is limited by the shallow sea floor, which varies between 17-22 m.

Habitat (Fig. 6)

The specimens of the large-scaled goby of Ostro and Selehovica, Bay of Kvarner, were found in a sublittoral habitat near the entrance of crevices on and at the foot of vertical or at least distinctly sloping rock faces. It is a bottom-dwelling and secretive species, apparently positively associated with boulders and rocks in combination with soft substratum (sand, mud or shell-gravel). *T. macrolepis* occurs mostly at areas with a steep gradient (< 40%), except at the sea-bottom, where it is always near the entrance to a crevice system. The small areas between rocks and boulders are mostly covered with sand

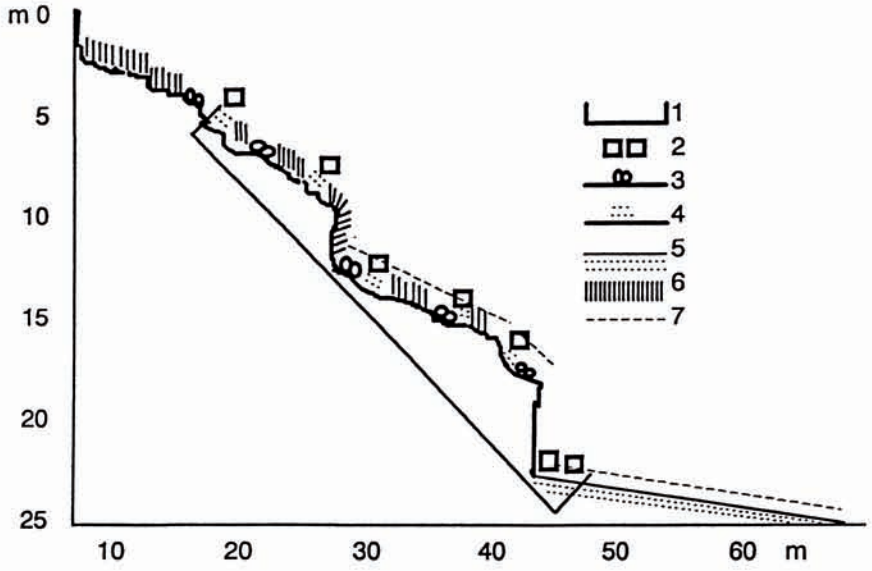

Fig. 5. - Profile of the sea-bottom in the investigated area at Ostro. 1: Depth range of *Thorogobius macrolepis*; 2: Position of *Thorogobius macrolepis* in the habitat; 3: Bedrock rarely covered with boulders; 4: Bedrock rarely covered with sand; 5: Sandy bottom; 6: Steady cover of photophilic algae; 7: Seasonal cover of alga *Polysiphonia* sp.

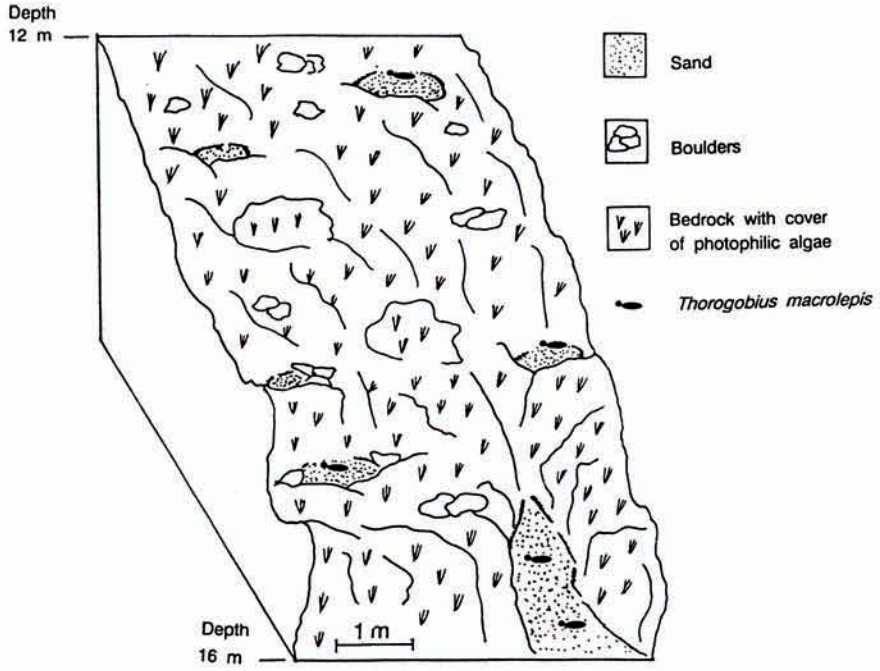

Fig. 6. - Habitat of *Thorogobius macrolepis* at the investigated area at Ostro.

and/or shell-gravel. At all places where the large-scaled goby occurs, this type of soft substratum is not mixed with mud or detritus.

In the upper part of the depth range of this species, the bedrock and boulders are covered by photophilic algae. They are replaced in greater depth by calcareous algae of the precorraligenous facies of the corraligenous biocoenosis (*Halimede tuna*, *Udotea petiolata*, *Peyssonelia squamaria*). The depth in which photophilic algae are replaced by calcareous algae in the Gulf of Kvarner varies due to varying ligth conditions throughout the gulf. In a few localities where *T. macrolepis* was observed, like in Ostro, the red alga *Polysiphonia* sp. occurs seasonally at 12 m to 15 m. Within this depth range the red alga forms a discontinuous layer on all kinds of substratum, but occurs only during the warm months of the year.

No differences were observed in habitat selection of adult or subadult specimens of either sex during the observation period from early June to late August.

It was conspicuous that, in contrast to the gobiid species *Gobius bucchichi* Steindachner, 1870, *G. fallax* Sarato, 1889 and *Zebrus zebrus* (Risso, 1826), no small juveniles of *T. macrolepis* were found at the collecting sites. Very small juveniles of the above three species and other gobiids were abundant during August. The smallest collected specimens of the large-scaled goby all exceed 30 mm TL. The size of the smallest observed specimens is estimated to be larger than 2 cm. Also, in contrast to the above-mentioned three gobiid species, no spawning activity of *T. macrolepis* was observable from early June to late August. It is possible that this species spawns later in the year.

In table III we summarize the epibenthic and hyperbenthic fish species which occupy the same habitat as *T. macrolepis*. The most common species are a gobiid, *Gobius vittatus* Vinciguerra 1883, and a serranid *Serranus hepatus* (L., 1758).

In two of the same transects in which *T. macrolepis* was observed, and in 7 of 32 investigated sites in the Gulf of Kvarner (Fig. 1), the closely related leopard-spotted goby, *T. ephippiatus*, was found. This species was less abundant than the large-scaled

Epibenthic	
Gobiidae	*Gobius cruentatus*
	Gobius fallax
	Gobius geniporus
	Gobius niger
	Gobius roulei
	Gobius vittatus
Blenniidae	*Parablennius rouxi*
	Parablennius tentacularis
Hyperbenthic	
Serranidae	*Serranus hepatus*
Labridae	*Coris julis*
	Symphodus (Crenilabrus) cinereus
	Symphodus (C.) ocellatus
	Symphodus (C.) tinca
	Symphodus (C.) mediterraneus

Table III. - Fish species usually seen in habitats with *Thorogobius macrolepis*.

goby. Its average density (0.09 ind./m^2) in populations in Ireland (Costello *et al.*, 1990; Costello, 1992) is apparently equally low in the Gulf of Kvarner. Even the depth range of *T. ephippiatus* (5-32 m) is similar to that of *T. macrolepis* (6-40 m). Both species are positively associated with boulders and rocks in combination with soft substratum. Outside of the crevice system, both species prefer lying on the soft substrate near the entrances to their hiding places. The difference in the habitat preference of both related species is that *T. ephippiatus* was only found in covered sites, similar as in the Lough Hyne population in Ireland (Costello, 1992), while *T. macrolepis* prefers open sites.

Distribution

T. macrolepis is an endemic Mediterranean species, known to date only from its western basin (Miller *et al.*, 1973; Ahnelt and Patzner, 1996) and the Adriatic Sea (Kolombatovic, 1891; and present data). The most northern record for this species is the northern Adriatic Sea.

DISCUSSION

The genus *Thorogobius* is currently represented by four species, of which two, *T. macrolepis* and *T. ephippiatus*, are known from the Mediterranean Sea, the latter also from the temperate eastern Atlantic. Both species occur inshore and are reported from depths down to 50 m. All species of this genus appear to prefer habitats somewhat deeper than many other gobiid species of the area (Miller, 1986). This also holds true for *T. rofeni* Miller 1988, a species which has been collected in the Gulf of Guinea at a depth between 650 to 260 m, thus representing one of the deepest records of a gobiid species (Miller, 1988).

Gobies which occupy deeper habitats may show specializations but also reductions of structures that are advantageous in the turbulent waters along the coast. Thus the two pelvic fins, which in most Mediterranean gobiids are united to a ventral disc, may be secondarily separated as in *Odondebuenia balearica* (Pellegrin and Fage, 1907) and *Vanneaugobius pruvoti* (Fage, 1907), or be more or less emarginate, as in *T. macrolepis* (Fig. 3). This tendency toward a separation of the pelvic fins is possibly a result of adaptation to habitats of less or non-turbulent waters. Species of the immediate shoreline have well-developed ventral sucking discs, whereas species inhabiting deep areas or showing cryptobenthic behavior may show less distinctly developed ventral discs or a tendency to separate pelvic fins. Similar to *T. macrolepis*, other gobiid species from deeper environments with low or non-turbulent currents such as *Corcyrogobius liechtensteini*, *Gammogobius steinitzi* or *Gobius vittatus* also have emarginate ventral discs.

Reduced head lateral-line systems can also be understand as an adaption to less turbulent or more or less linear water movements, e.g. in species of the genus *Lesueurigobius*. How far an intraspecific variability of this sensory system may be interpreted in this sense remains to be determined. Nevertheless, it is noteworthy that some specimens of the investigated *T. macrolepis* population lack parts of the sensory papillae rows. This is obvious in the transversal suborbital row ***5***, which is usually divided by the horizontal row ***b*** into an upper and a lower part (***5s*** and ***5i*** respectively). In the 23 investigated specimens, ***5i*** is always developed but ***5s*** is lacking in two specimens on the left side (Fig. 4A). Varying development of sensory papillae rows within a species is the exception for most gobiids of the Mediterranean Sea (Sanzo, 1911; De Buen, 1923; Miller,

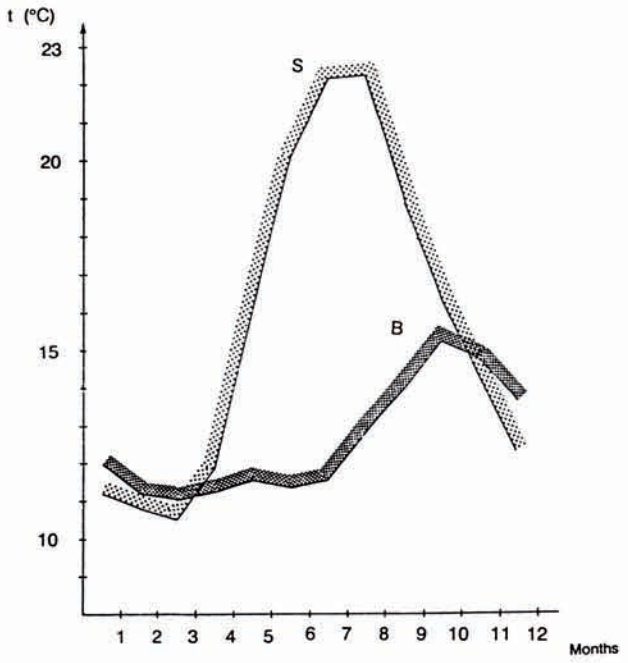

Fig. 7. - Seasonal variations of water temperature in the Bay of Rijeka at the surface (S) and at the bottom (B).

1986). Not much is known of the intraspecific variability of the head lateral-line system of gobiid fishes in general. More comparative material of *T. macrolepis* from different areas of the Mediterranean Sea has to be studied before deciding whether the absence of the dorsal part of the suborbital sensory papillae rwo *5* in a few specimens is aberrant or reflects a certain variability of the head lateral-line system within this species. The importance of knowing the intraspecific variability is evident for *Chromogobius zebratus* (Kolombatovic, 1891), a species which until recently was separated into two subspecies (Ahnelt, 1990; Ahnelt and Patzner, 1996).

Finally, it should be noted that the northern Adriatic Sea is a shallow and therefore geologically young sea. During the last (Würmian) glaciation the level of the oceans dropped to at least 120 m below the present one (Bianco, 1990; Springer and Williams, 1990). The area north of Split was thus land, drained by the system of the River Po. This indicates not only that the *T. macrolepis* population from the Bay of Kvarner is not older than several thousand years, but also has ecological implications. One of this pertains to the tolerance of cool temperatures. The water temperatures in this shallow part of the Adriatic Sea are much more influenced by the cold winter months than those of deeper Mediterranean areas. The water temperature of the Bay of Rijeka varies at the surface from 8.8°C during the winter to 22.2°C during the summer, with the values at the inshore bottom ranging from 8.6°C to 16.4°C (Anonymous, 1982) (Fig. 7); in the deeper parts of the Adriatic Sea it never drops below 11-12°C (Peres and Gamulin-Brida, 1973). During the summer months of 1995 the temperature at the surface reached 22-27°C at Ostro, but at the upper limit of the depth range of *T. macrolepis* it never exceeded 20°C.

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